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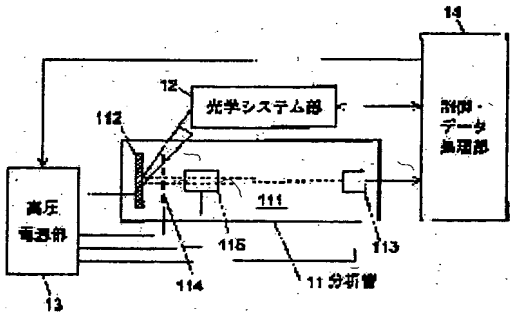
(54) MASS SPECTROMETRY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To execute analysis by an internal standard method with high accuracy, in a mass spectrometry device for ionizing a sample by irradiating the sample with a pulse laser and for analyzing it.
SOLUTION: A laser beam from a laser light source is divided into two beams by a beam splitter, and applied simultaneously toward two sample plates on a sample stand 112. As an unknown sample and a reference standard sample can be placed separately on each sample plate, each sample can be ionized by using a matrix suitable for each sample and by a laser beam having energy suitable for each sample. Ions produced on the two sample plates are focused toward a detector 113 by an ion lens. Hereby, mass spectrometry of both the ions of the unknown sample and the ions of the reference standard sample can be executed under the same conditions. Therefore, an internal standard analysis having high accuracy can be executed.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] By irradiating a laser beam, this invention ionizes a sample and relates to the mass spectroscope which analyzes.
[0002]
[Description of the Prior Art] Time-of-flight-mass-spectrometry equipment (TOFMS=Time of Flight Mass Spectrometer) is in one of such the mass spectroscopes. TOFMS introduces the accelerated ion in the flight space which does not have electric field and a magnetic field, and divides various ion into every mass number (m/z) according to time of flight until it reaches a detector. Drawing 3 is the outline block diagram of the important section of the conventional TOFMS which has the simplest composition. The mass separation section 22 is inserted, the ion source 21 is arranged on the left and the detecting element 23 is arranged on the right. The sample base 211 of the ion source 21, the drawer electrode 221 of the mass separation section 22 and an end plate 223, and the detector 231 of a detecting element 23 are arranged in the shape of a straight line along with the ion optical axis C. It is mixed with a matrix (heating adjuvant) and a sample 212 is laid in the planchet 213 prepared in the sample base 211. The sample base 211 which laid one or more samples 212 in each planchet 213 is inserted in equipment, and the planchet 213 which laid the sample 212 for the purpose of analysis is put on a position.
[0003] In the case of measurement, in a laser light source 241, the laser beam of the shape of a pulse of an ultrashort time is generated, and the above-mentioned predetermined position irradiates by the laser beam study system 242. Through a matrix, a sample 212 is heated in an instant and ionized. The various ion generated from the sample 212 is pulled out with the sample base 211, and the potential difference Vs between electrodes 221 draws it out, and it is pulled out in the direction of an electrode 221, and after being accelerated, it is introduced into the flight space 222 which does not have electric field and a magnetic field. Since speed with the smaller, higher ion of the mass number can be given at this time, it passes through the flight space 222 early more, and a detector 231 is reached.
[0004]
[Problem(s) to be Solved by the Invention] In order to determine the mass number of the ion from the time of flight of each ion measured by TOFMS, it is necessary to fly the ion which has the known mass number on the same conditions, and to measure and compare the time of flight. Moreover, in order to carry out precision mass analysis of each component of a sample, on the same conditions, the standard sample of a known content must be ionized and must be flown (internal standardization). However, since the intensity generally varies for every irradiation, in order to analyze a strange sample with high precision, the laser beam irradiated by the sample, especially a pulse laser must mix a strange sample and a reference standard sample, must put them on the same planchet of a sample base, and must be simultaneously heated and ionized by one laser beam irradiation.
[0005] However, generally the optimal laser energy for ionizing each sample differs. Moreover, if suitable matrices also differ for every sample and mix them, it may deteriorate, or it may decompose.

[0006] By irradiating a laser beam, the place which accomplishes this invention in order to solve

such a technical problem, and is made into the purpose ionizes a sample, and is in the mass spectroscope which analyzes to offer the equipment which can perform analysis by internal standardization with high precision.

[0007]

[Means for Solving the Problem] this invention accomplished in order to solve the above-mentioned technical problem In the mass spectroscope which irradiates a laser beam at the sample in the planchet on the sample base established in the predetermined position, generates ion, and is fed into the mass separation section a) The optical splitter which makes the laser beam which it has been arranged between a laser light source and the above-mentioned predetermined position, and was emitted from the laser light source irradiate two planchets on a sample base simultaneously, b) It is characterized by having an ion optics system for feeding into the mass separation section both the ion generated by the two above-mentioned planchets.

[0008]

[The gestalt and effect] of implementation of invention With an optical splitter, the laser beam emitted from the laser light source is divided into two, and is simultaneously irradiated by two planchets on a sample base. The sample laid in both planchets is ionized by the laser beam, and is sent to the mass separation section by the ion optics system. In the mass separation section, mass separation of both the samples is carried out on the same conditions. Thus, in the mass spectroscope concerning this invention, since a pulse laser is separately irradiated by two planchets, it can lay independently in each planchet, without mixing the sample of another kind. For this reason, to each sample, the optimal matrix can be used, respectively, it is efficient and each sample can be ionized.

[0009] Moreover, since a laser beam is simultaneously irradiated by each sample, it becomes the analysis apparatus which was suitable like TOFMS when the simultaneity of ion generation was required. However, even if it is the mass spectroscope as which the simultaneity of ion generation is not required, this invention is applicable to the analysis apparatus which employed the advantage by independent installation of the above samples efficiently.

[0010] In the mass spectroscope of the above-mentioned composition, highly precise analysis is attained by putting a proper filter on the optical path of the pulse laser of either or both sides, and making into the respectively optimal value energy of the pulse laser which irradiates each sample.

[0011] In the mass spectroscope concerning this invention, usage of laying a reference standard sample in the planchet of another side for the strange sample which it is going to analyze to the planchet which is one side, for example can be carried out. Since it is ionizable by the laser beam of energy which used the matrix suitable for each sample by this, and was suitable for each sample, each sample can be ionized most efficiently. Thus, it becomes possible by using the mass spectroscope concerning this invention to perform analysis by internal standardization with high degree of accuracy.

[0012]

[Example] Drawing 1 and drawing 2 explain the example which applied this invention to TOFMS. TOFMS is equipped with an analyzer tube 11, the optical system section 12, the high-voltage-power-supply section 13, and the control-data processing section 14 grade as shown in drawing 1 . The space 111 for ion flying is formed in the analyzer tube 11, and the detector 113 which detects the ion to which the standing ways for fixing the sample base 112 inserted in from the outside fly in the other-end section is formed in the edge of one of these. The focal lens 115 which turns and completes the drawer grid electrode 114 and ion which pull out the ion generated on the sample base 112 ahead of the sample base 112, and are accelerated as a detector 113 is formed.

[0013] Drawing 2 explains the portions of the optical system section 12 and an analyzer tube 11 in detail. The optical system section 12 is equipped with the laser oscillation machine 121 and a beam splitter 122, and the laser beam emitted from the laser oscillation machine 121 is first divided into two laser beams La and Lb by the beam splitter 122. A beam splitter 122 consists of a half-transparency mirror, and the laser beam reflected there goes to the total reflection mirror 123. The laser oscillation machine 121 is set up so that the planchet of the 1st predetermined position on the sample base 112 where the laser beam La which passed the beam splitter 122 was fixed on standing ways may be irradiated, and the total reflection mirror 123 is set up so that the laser beam Lb of another side may irradiate the planchet of the 2nd predetermined position on the sample base 112.

Filters 124a and 124b and condenser lenses 125a and 125b are formed in the optical path of both the laser beams La and Lb, respectively. Filters 124a and 124b are for adjusting the energy of the permeability of each laser beams La and Lb, i.e., the laser beam irradiated by each sample.

[0014] The procedure in the case of analyzing a strange sample by TOFMS of this example is as follows. First, the reference standard sample Sb is laid in the planchet which adjoins one planchet of the sample base 112 in the strange sample Sa. The optimal matrix for each can be used for each samples Sa and Sb at this time. The sample base 112 in which both the samples Sa and Sb were laid is inserted in an analyzer tube 11, and the lid of the sample insertion section is shut. If it points to an analytic procedure (program) in the control-data processing section 14 and a measurement start button is pushed when an operator operates the control units (a keyboard, mouse, etc.) of the control-data processing section 14, the control-data processing section 14 will start a series of analysis in alignment with the directed program. First, the opening-and-closing valve and vacuum pump of each part are operated, and it is made for the flight space 111 to serve as a predetermined degree of vacuum.

[0015] In the case of analysis of a strange sample, the planchet of the strange sample Sa moves the sample base 112 so that the predetermined position of the above 1st and the planchet of a standard sample Sb may come to the 2nd predetermined position (reverse is sufficient). And a signal is sent to the laser oscillation machine 121, and the pulse laser of an ultrashort time is generated. A pulse laser is divided into two by the beam splitter, is irradiated by the strange sample Sa and standard sample Sb on each planchet, and makes each sample heat and ionize. Here, the filters 124a and 124b of each optical path serve as a case index, and the control-data processing section 14 chooses the filters 124a and 124b of suitable permeability for every optical path so that the laser beams La and Lb of the optimal energy for ionization of each samples Sa and Sb may be irradiated.

[0016] The ion of each generated sample is pulled out by the drawer electrode 114, and is accelerated. In spite of having generated each ion by which planchet, according to the mass number (m/z), it is accelerated on the same conditions, and it is sent to a detector 113 with the focal lens 115. For this reason, in the mass spectrum which consists of ion of the strange sample Sa, and ion of a standard sample Sb, the quality and precision mass analysis of the strange sample Sa which referred to the standard sample Sb are performed with high precision.

[Translation done.]